

### ABSTRACT OF THE INVENTION

A chemical reactor for direct conversion of hydrocarbons includes a dielectric barrier discharge plasma cell and a solid oxide electrochemical cell in fluid communication therewith. The discharge plasma cell comprises a pair of electrodes separated by a dielectric material and passageway therebetween. The electrochemical cell comprises a mixed-conducting solid oxide electrolyte membrane tube positioned between a porous cathode and a porous anode, and a gas inlet tube for feeding oxygen containing gas to the porous cathode. An inlet is provided for feeding hydrocarbons to the passageway of the discharge plasma cell, and an outlet is provided for discharging reaction products from the reactor. A packed bed catalyst may optionally be used in the reactor to increase efficiency of conversion. The reactor can be modified to allow use of a light source for directing ultraviolet light into the discharge plasma cell and the electrochemical cell.